Space Weather Technical Forecast

Issued on Sunday, 06 November 2022 at 12:21 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

---

Space Weather Forecast Headline: Slight chance G1/minor storms from days 3 and 4 (8th-9th). Slight chance of M-class flares (R1; Minor radio blackouts) throughout. Active fluence (1e8 integrated pfu) likely through much of the period.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been Low through the last 24 hours, with a low level C-class flare observed at 06/0113 UTC from the largest region on the visible disc AR3141. There are six numbered active regions, which are mainly covering the northern hemisphere. The aforementioned large region AR3141 in the northeast, and two moderately sized spots with one in the northeast, AR3140, and the second in the northwest AR3135. The remaining spots AR3136, AR3137 and AR3139 are small and simple. No significant Earth-directed coronal mass ejections are anticipated.

Solar Wind / Geomagnetic Activity: The solar wind, observed by DSCOVR at L1, is showing a declining influence from coronal hole 39 with speeds easing from an elevated level of 500km/s to slightly elevated at 420km/s. Density nudged downwards from near average to below average levels to end the period at 3pppc. Total magnetic field strength, IMF, has been weak with a mostly declining trend with levels remaining below 5nT. The north-south component, Bz has varied weakly, with a mostly negative bias noted, ranging from +2/-4nT. Phi angle has been mostly positive (away from the Sun). Geomagnetic activity was observed to be at Quiet levels (Kp 1-2).

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) as measured at GOES-16 has remained at background levels. High energy electron flux (greater than 2 MeV) at GOES-16 has remained at high levels, reaching a peak of 8.03e3 pfu at 05/1615UTC. Electron fluence levels have steadily risen to reach 3.71e8 integrated pfu at 06/0000 UTC, with further rises in the past 12 hours.

Four-Day Space Weather Forecast Summary

Solar Activity: Solar activity is forecast to be Low or Very Low, with a chance (20%)of Moderate activity. There also remains a risk from further regions rotating onto the disc from the far side of the Sun.

Solar Wind / Geomagnetic Activity: No Earth directed CMEs feature in the forecast. The high speed stream from coronal hole 39 is expected to continue to decline to slow-ambient levels by day 2 (7th). Coronal hole 42 may then connect with the Earth during day 3 (8th), although there is low confidence in the strength of any connection. There is a chance that the Earth may connect to coronal holes 40 or 41 on day 4 (9th), though their impact on the Earth is expected to be minimal due to their negative polarity. Geomagnetic activity is expected to be Quiet to Unsettled, but there is a slight chance of Active or G1/Minor Storm intervals on days 3 and 4 (8th-9th) due to successive arrivals of coronal hole high speed streams.

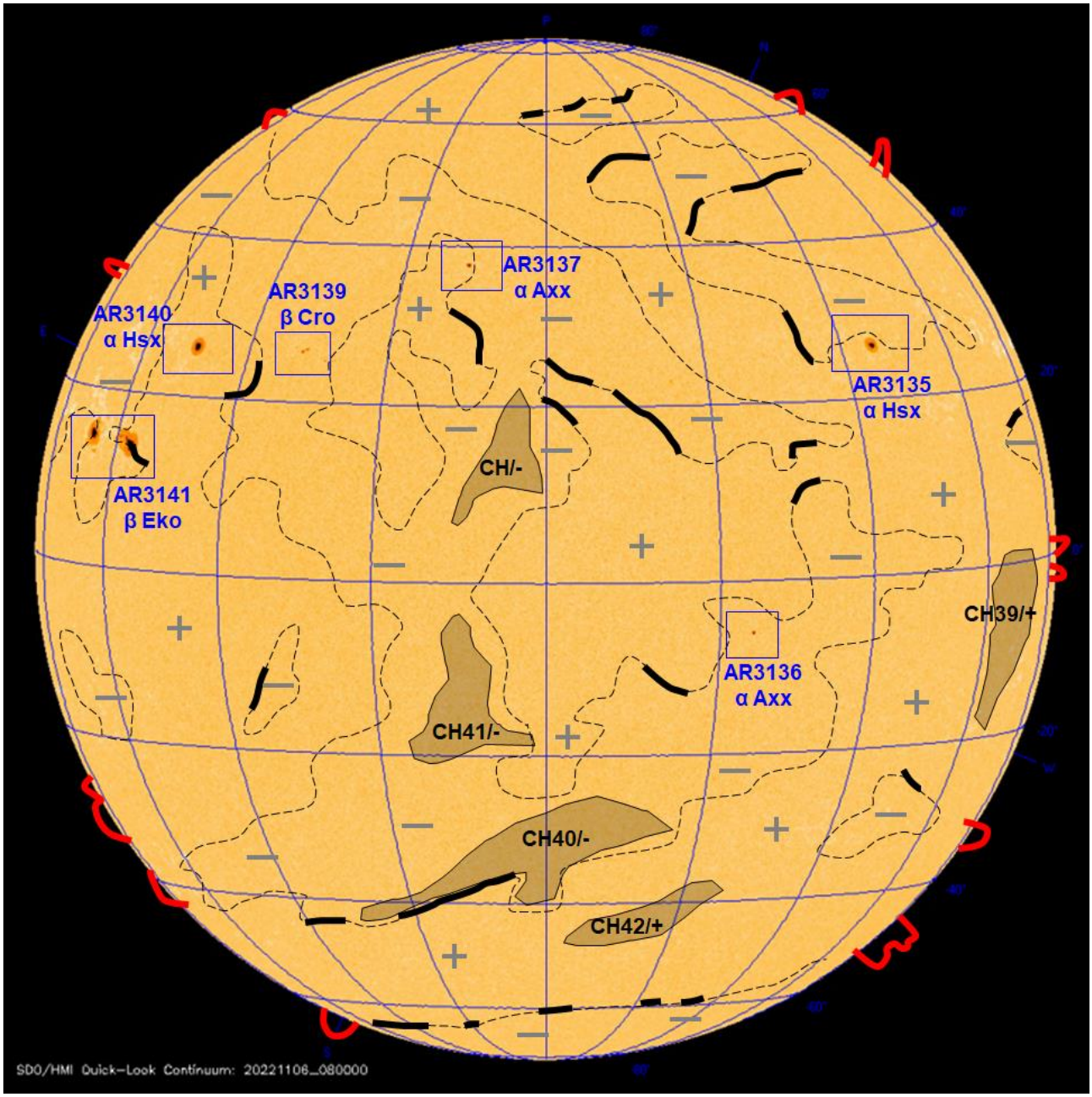
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) observed by GOES-16 is expected to be at background levels. High energy electron flux (greater than 2MeV) is expected to continue at high levels much of the period. Electron fluence values are expected to remain above the Active (1e8 integrated pfu) threshold through the period due to elevated electron flux values, with a slight chance of reaching Very High (1e9 integrated pfu) levels later in the guidance period.

Figure 1. Solar Analysis Valid 0800UTC, 06 November 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Geomagnetic Storms:

No Earth directed CMEs feature in the forecast.

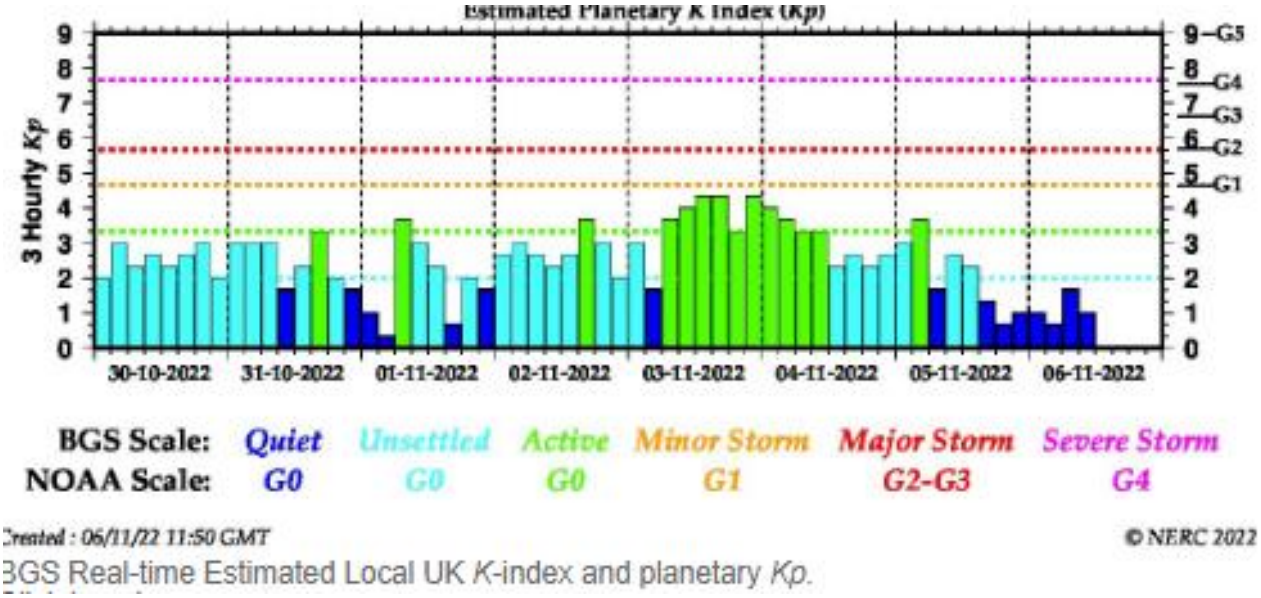
The high speed stream from CH39+ continues to wane and solar winds as measured by DSCOVR at L1 will probably reach slow-ambient levels in the next 12 hours. Coronal hole 42 may then connect with the Earth during day 3 (8th), although there is low confidence in the strength of any connection. There is a chance that the Earth may connect to coronal holes 40 or 41 on day 4 (9th), however their impact on the Earth is expected to be minimal due to their negative polarity as we slowly edge away from the autumn equinox.
Geomagnetic activity is expected to be mainly Quiet with some Unsettled intervals possible at times. There is a slight perhaps increasing chance of Active or G1/Minor Storm intervals on days 3 and 4 (8th-9th) due to successive arrivals of coronal hole high speed streams.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	1	1	5	10
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Nil.

Figure 2: BGS Magnetometer data over the past seven days with levels declining over the past 24 hours.



BGS Real-time Estimated Local UK *K*-index and planetary *Kp*.

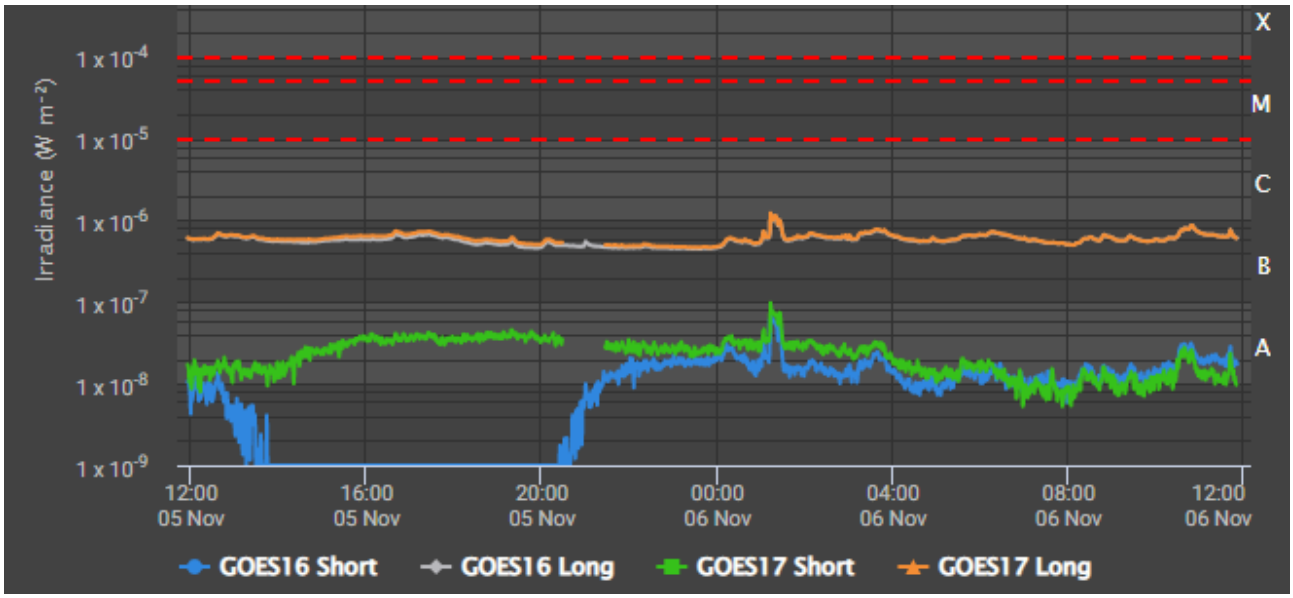
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Radio Blackouts - X-Ray Flares:
There are six numbered active regions on the visible disc. AR3141 in the northeast remains the largest and most complex region on the disk, classified Eko/Beta with a large leader and large trailing spot. AR3140 in the northeast is the second largest region, with a moderately sized mature spot Hsx/Alpha. A moderately sized unipolar spot, AR3135, in the northwestern hemisphere has changed little and remains Hsx/Alpha. AR3139 in the northeast has displayed some changes to the intermediates spots with a rudimentary umbra, Cro/Beta. The remaining two regions, AR3136 in the southwest and AR3137 in the northeast, remain small unipolar Axx/Alpha. Solar activity has been Low, with a C1 flare observed at 06/0113 UTC. Activity will probably continue Low perhaps Very Low, but there is a chance (20%) of an isolated M-class flare originating from AR3141 to give Moderate solar activity.

X Ray Flares Probability	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	R1-R2 M Class	No	20	20	20	20
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray flux plot at GEO as observed by GOES.



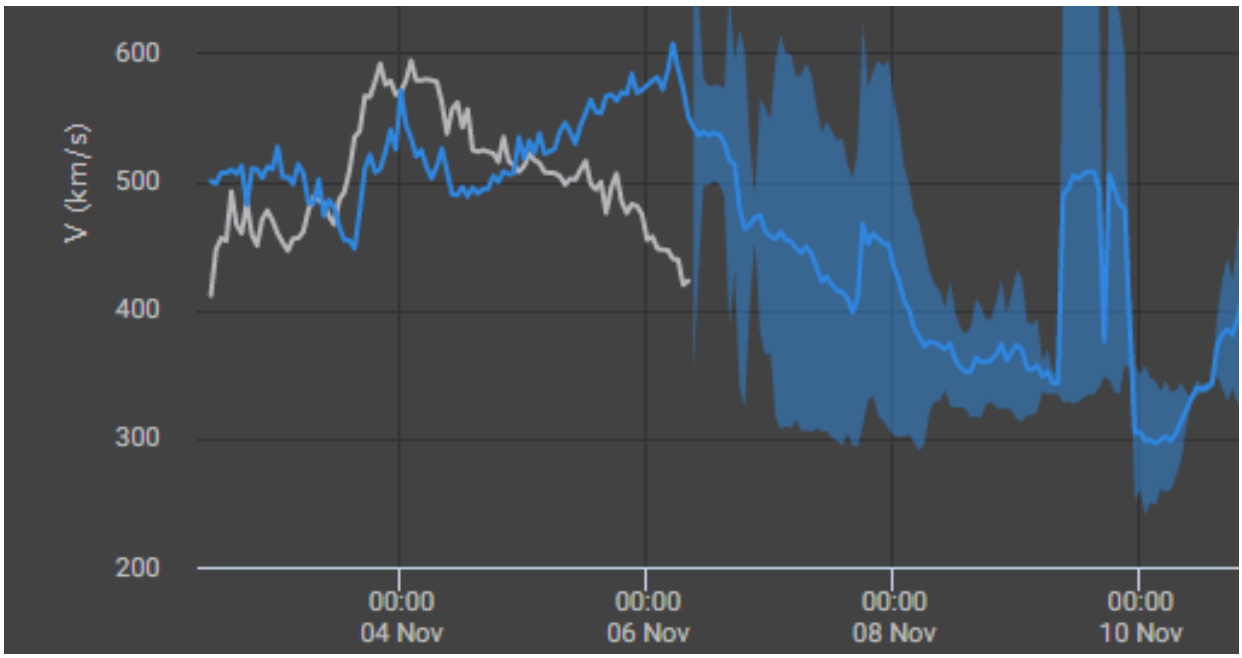
Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

Solar Radiation Storms - (High Energy Protons):
The high energy proton flux (greater than 10 MeV) at GEO, observed by GOES-16 is currently at background levels and is forecast to remain at this level through the guidance period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1
* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)						

Figure 4: Met Office Solar Winds Prediction Model (SWPM), indicating a decline in coming days.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.

High Energy Electrons Event (≥ 2MeV):

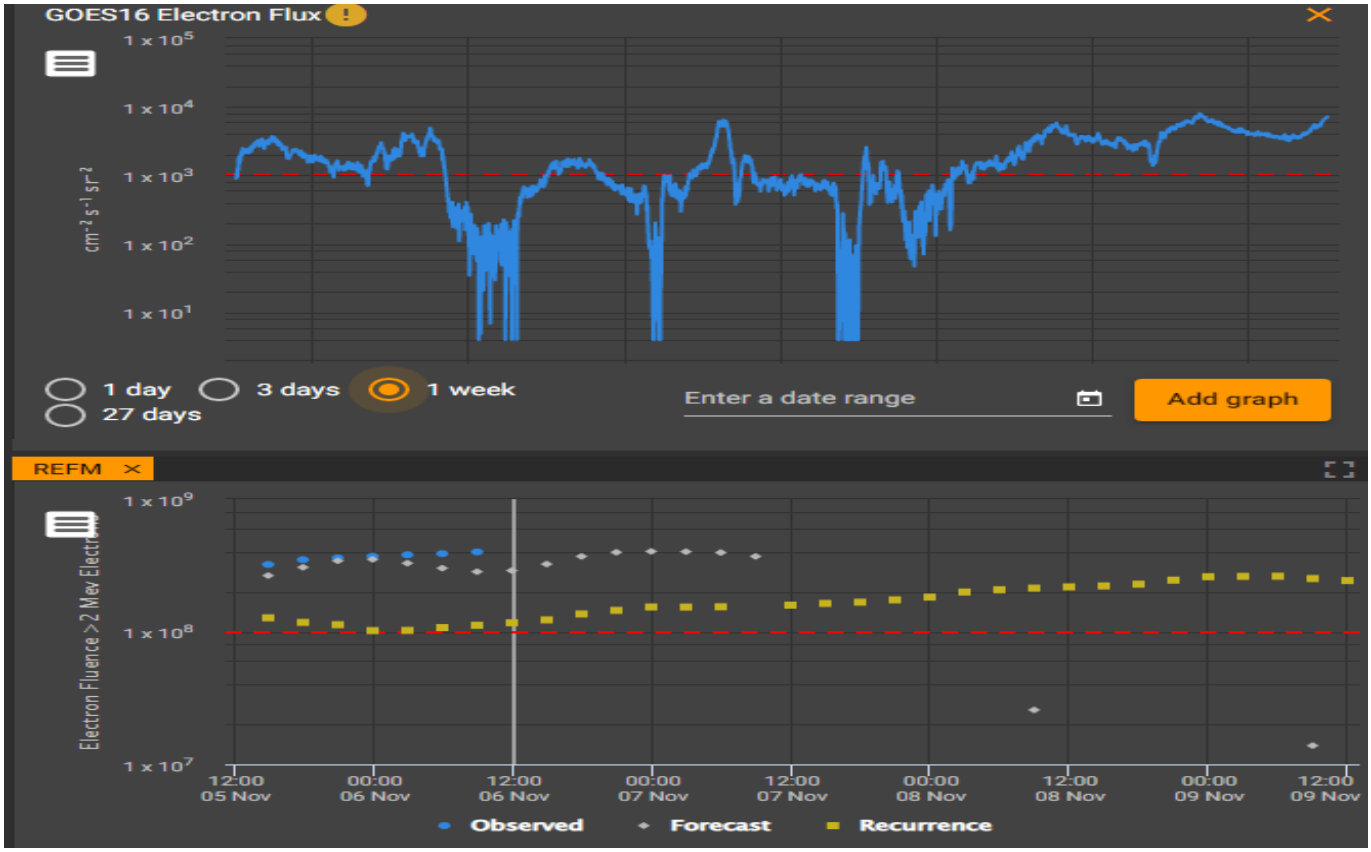
The high energy electron flux (greater than 2MeV) has remained at high levels over the past 24 hours with this likely to continue as a result of the recent input into the radiation belts. These levels will probably be maintained for much of the coming guidance period given that no significant geomagnetic activity expected. Brief declines are possible due to diurnal variations, but these are unlikely to be sustained.

Electron fluence has risen sharply in response to the increase flux and is expected to remain above the Active threshold (1e8 integrated pfu) for much of the period. The risk is considered lower towards the end of the period simply due to reduced confidence in any geomagnetic activity and rate of electron losses in the radiation belts.

There remains a slight chance of reaching Very High (1e9 integrated pfu) levels through the period.

GEO Electron Environment	Level ($cm^{-2}\ sr^{-1}\ day^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ 2 MeV ≥ $1x10^8$	Yes	100	90	80	70
Very Active	≥ 2 MeV ≥ $1x10^9$	No	1	5	20	10

Figure 5: High energy electron flux and Met Office REFM output showing current moderate to high levels.



Issued by Met Office Space Weather Advisor, Tel: +44 (0) 330 135 4254 Email: moswoc@metoffice.gov.uk

© Crown Copyright 2022. All Rights Reserved.